



The Next Generation Touch Technology Experience

Choosing the right PCAP solution for your next design project

Executive Summary

Not all touchscreen technologies are created equal. At Elo we offer our customers multiple choices of touch technologies based on their requirements and budget. Tablets and smartphones currently on the market mostly incorporate projected capacitive touchscreen technology ("PCT" or "PCAP") as it is the most advanced touch solution available today. However, such high-grade technology comes at a significant cost that incrementally increases by screen size, which is why the progress of PCAP market share has been limited to smaller devices. Until now, scaling PCAP to larger screen sizes, 24+ inches, has deterred many customers, but Elo is changing that with its latest generation of PCAP touch screens.



Table of Contents

1. Touch Technology Overview
2. Benefits of PCAP Technology
3. Types of PCAP Constructions
4. Tuning for Optimization
5. Next Generation Touch

1. Touch Technology Overview

As the interactive technology sector experiences strong growth, understanding the touchscreen technology powering the experience is more important than ever. With decades of proven use in consumer settings, projected capacitive (PCAP) touch technology is likely a technology you will encounter more and more in industrial, medical, retail, gaming and self-service applications.

Why does the touch technology matter?

Many technology options are available for interactive touch displays such as resistive, infrared, optical, surface acoustic wave (SAW) and surface capacitive solutions (SCAP), some of which have been powering touch applications successfully for over 40 years. Touch technology is found in almost every industry including medical, industrial, retail, hospitality, transportation and banking. Each touch solution has its place within specific users, applications and environments based on requirements and characteristics of the technology itself. Considerations include whether the user engages the touch screen with a stylus, fingertip or glove, appropriate temperature range, importance of optical clarity, necessary level of vandal resistance, cost sensitivity, as well as many other factors. However, for many applications one solution performs far better than the rest in terms of functionality and performance requirements – PCAP. Considered the best-in-class touch technology, PCAP is becoming more affordable and accessible. PCAP is the most recognized and pervasive touchscreen solution we interact with on a daily basis as it powers the technology in our pockets – our smartphones.

2. Benefits of PCAP Technology

The benefits of PCAP technology are numerous. PCAP technology allows simultaneous 10+ finger multi-touch with fast, accurate and extremely sensitive touch response and supports optional surface treatments like anti-glare and anti-vandal glass. PCAP can be designed to avoid false touches from liquids and functions even with deep scratches when implemented properly. PCAP allows for zero bezel or so called edge-to-edge cover glass designs resulting in a modern appearance that in addition is very easy to clean. PCAP is capable of registering touch through

additional cover glass of 6mm or more with slight trade-off in accuracy and number of touches but still works great in outdoor ticketing machines subject to vandalism or touch displays positioned under glass countertops.

3. Types of PCAP Constructions

PCAP is available in many different variations, each with specific costs and functional outcomes. The core design of PCAP begins with two grids of conductive traces patterned vertically and horizontally for X and Y axes, laminated together with a glass cover layer. An oscillating frequency electronic signal creates an electric field which projects through and above the glass. A finger (or capacitive object) touch disturbs the electric field and the controller interprets this to pinpoint the touch location. Multiple simultaneous touches can be detected. Variations in stack-up constructions of PCAP relate to the different methods by which the conductive grid is created and applied to glass or plastic film. The availability of numerous PCAP constructions and conductive trace material options can make narrowing in on the right solution for your application challenging. To ensure the best performance and lowest maintenance and failure rates, customers must choose a PCAP variant proven to work in their intended application.



Different types of Elo PCAP constructions

GF2 – Glass, Film (double sided)

GFF – Glass, Film, Film

2GS – Glass, Glass

3GS – Glass, Glass, Glass

Some consumer grade PCAP constructions are not suitable for commercial use

There are many variants of consumer style PCAP that would not work well in commercial applications. We are only addressing a few of the most common ones here.

With OnCell and InCell designs, PCAP touch sensors are integrated *into* LCD displays with the PCAP sensor patterns being functionally embedded onto or within the display layers of the LCD. This type of technology is found in common consumer applications including smart phones, tablets and laptops. Noise sensitivity, cost and other technical hurdles make these technologies unsuitable for demanding commercial applications, especially for larger sizes 20 inches and above.

The so called one film designs or GF consists of a passive cover glass bonded to a single-layer film sensor. Conductive traces –both transmit and receive lines - are combined on the same side of the PET film (a type of plastic). This type of sensor is limited to smaller devices and applications requiring lower accuracy.

GF2 double sided film construction (Elo Pro-F)

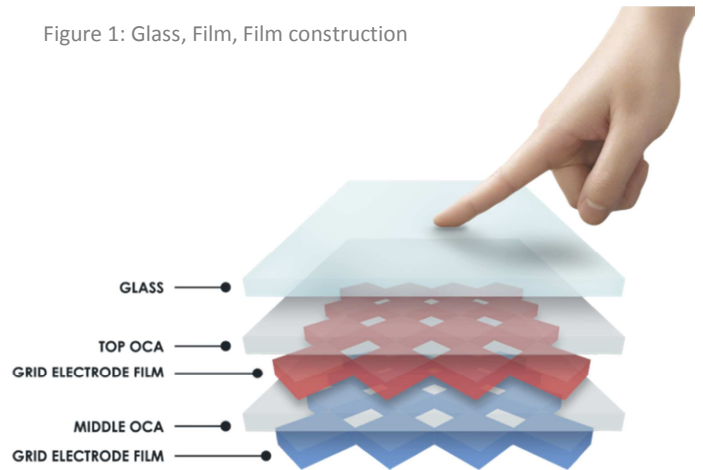
GF2 (Glass, Film) design consists of a passive cover glass bonded to a single-layer film sensor which has conductive traces on *both* sides. Conductive traces can be ITO (Indium Tin Oxide) or other material such as copper mesh or silver metal halide. This design is optimized for devices sized from 4 to 24 inches. GF2 designs boast advantages including being light weight, allowing for small border widths and supporting single tail connection solutions. Elo manufactures GF2 solutions using a proprietary ITO-replacement film material with good optical performance and the durability required for commercial installations. Elo’s GF2 line, called Pro-F, is a good alternative to 2GS as GF2 delivers both notable reductions in product weight and cost with only a slight tradeoff in optical transmissivity.

GFF dual film constructions (Elo Pro-F and Pro-M)

GFF (Glass, Film, Film) design consists of a passive cover glass bonded to a double layer of film sensors laminated together with Optically Clear Adhesive (OCA). The conductive grids are deposited onto thin PET film material.

Various competing technologies can be used for the conductive substrate including silver nano-wires, silver metal mesh or embedded wires but typically in the industry ITO is used for sizes less than 24 inches. For applications larger than 24 inches Elo offers Pro-M PCAP touchscreens which utilize a similar GFF stack-up (see figure 1).

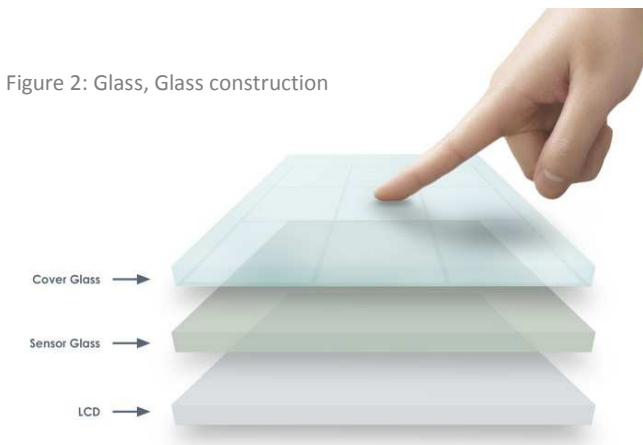
Figure 1: Glass, Film, Film construction



Pro-M design uses a highly transparent silver metal mesh film with tiny electrodes carefully arranged in a grid/mesh pattern on layers of plastic film. The silver metal mesh wire widths are so small, 4-7 um, they cannot be seen with the naked eye, which allows Pro-M designs to deliver a very sensitive touch experience without Moire issues. Conductive layer constructions utilizing technology other than metal mesh will have visibly embedded wires that may distract the user and take away from aesthetics of the screen. Mesh is typically used in large display sizes from 32 to 70 inches or greater. Elo’s Pro-M touchscreens are available in standard and custom sizes from 32 to 85 inches.

Glass Constructions (Pro-G)

2GS ("Glass-Glass") design consists of two glass layers – cover glass and sensor glass – both patterned with ITO conductive traces on a single side. The conductive glass sides are then laminated together using OCA. 2GS offers pristine optical clarity, high durability and long term stability over temperature, making it a great choice for demanding commercial and industrial applications up to 24 inches where weight and overall thickness aren't primary concerns (see figure 2).



3GS is also available and used when there is a need for special cover glass materials such as Gorilla glass or polycarbonate. Glass only constructions are always better from an optical performance standpoint compared to film.

2GS and 3GS offer a naturally robust laminated glass structure. Film based PCAP sensors can also be designed with additional robustness through extra laminated layers or thicker, toughened cover glass. Because of this it's important to work with an experienced touch technology provider to guide you to the best structure for your particular application.

Choosing the right PCAP

Choosing the proper projected capacitive touchscreen structure is crucial for commercial applications requiring long service life and subject to a high use rate and demanding environmental conditions. Many factors influence the ideal touch solution, including but not limited to:

- Does it need to operate through a thick layer of vandal-resistant glass or polycarbonate?

- Does it need to guarantee no false touches when exposed to water?
- Will it be exposed to conductive fluids such as sea water or saline?
- What regular environmental conditions or extremes will it be exposed to?
- What maximum total screen thickness is required to fit within your mechanical design?
- Does it need to work outside with users wearing polarized sunglasses?

Working with an experienced touch solution provider to help select and design the appropriate PCAP for your application is highly recommended in order to ensure these types of considerations aren't overlooked. Elo has been designing touch solutions from the ground up for over 40 years and offers world-class design, test and manufacturing capabilities.

Partnering with a reputable touch solution provider is not only important in guiding you to optimal screen technology selection and design for your application, but also to ensure long-term reliability of screen quality and supply. For quite some time there has been a proliferation of manufacturers producing low quality GFF screens at very low cost. This overcapacity of PCAP manufacturing drives those manufacturers to cut costs in effort to stay competitive and thereby disregard design quality and reliability. Unfortunately some of those low quality screens made their way into the market early on for PCAP, creating an unwarranted stigma for film designs as a whole. However, concerns such as film yellowing and delamination are easily mitigated through proper material choice and quality manufacturing in a clean-room environment. Hundreds of grades of PET film exist so choosing the right one is critical when choosing the material used in the touch screen. Yes, there are very low cost PCAP screens available on the market but, in general, you get what you pay for and it's wise to be wary of ultra-low cost touchscreens and the business viability of the manufacturers offering them.

4. Tuning for Optimization

Unlike resistive, SAW, and IR solutions, PCAP requires tuning of controller parameters that are specific to each

touch sensor design and are optimized for the particular display panel and product application. Full touchscreen solution providers such as Elo who offer both touchscreen design and controller solutions are best suited for supporting PCAP rather than sourcing touch sensors and controllers with different vendors. A single vendor responsible for the performance and testing of a complete solution will ensure performance is equally driven by touch panel design, controller capabilities, management of display electrical noise and controller tuning.

The controller's role in creating a properly functioning touch solution should not be underestimated. Matching the right controller to the selected sensor technology is critical in meeting the end customers' requirements. The use, as an example, of Self Capacitance sensing for an application that requires liquid rejection takes a company that has expertise in tuning for these scenarios. The ability to create specific firmware and tuning files to enable touch performance in a number of diverse scenarios is particularly important.

A company with a single choice of controller technology will limit the ability to meet the projects requirements.

5. Next Generation Touch

Elo is today able to offer competitive solutions for all its commercial PCAP products. By establishing our own high-volume manufacturing facility and best-in-class automated production equipment, Elo is able to produce commercial grade PCAP solutions at affordable levels.

Elo continues to support and invest in our Resistive and SAW (Surface Acoustic Wave) technologies in addition to its newest PCAP offerings. We believe that it is worth keeping in mind that there is more than one technology when choosing what is right for your application.

Customers considering PCAP technology should work with a touchscreen provider early on in their development cycle to integrate the touchscreen design into the full system concept, similar to a smartphone, because PCAP screens added as an afterthought to a non-touch monitor will not have the same level of quality and durability.

Elo offers an expansive portfolio of solutions ranging from independent touchscreens and tuned controllers to completely integrated LCM assemblies with touchscreens bonded to LCDs. Touch technology is the core business of Elo. All Elo touchscreens and monitors are designed in house from initial concept and are validated all the way through final touchscreens, software drivers and other components being assembled and tested together for optimum performance.

Millions of Elo's touch screen solutions have been deployed and proven in around the world in a wide range of environments for over 40 years.

Visit www.elotouch.com to learn more about how Elo is reinventing the touch experience

About Elo

Elo is a global leader in touch screen solutions. The inventor of the touchscreen, Elo now has 20+ million installations in 80+ countries. The Elo portfolio encompasses the broadest selection of OEM touchscreen components, touchscreen monitors and displays as well as all-in-one touch computers for the demanding requirements of diverse markets, including gaming machines, hospitality systems, industrial automation, interactive kiosks, healthcare, office equipment, point-of-sale terminals, retail displays and transportation applications.